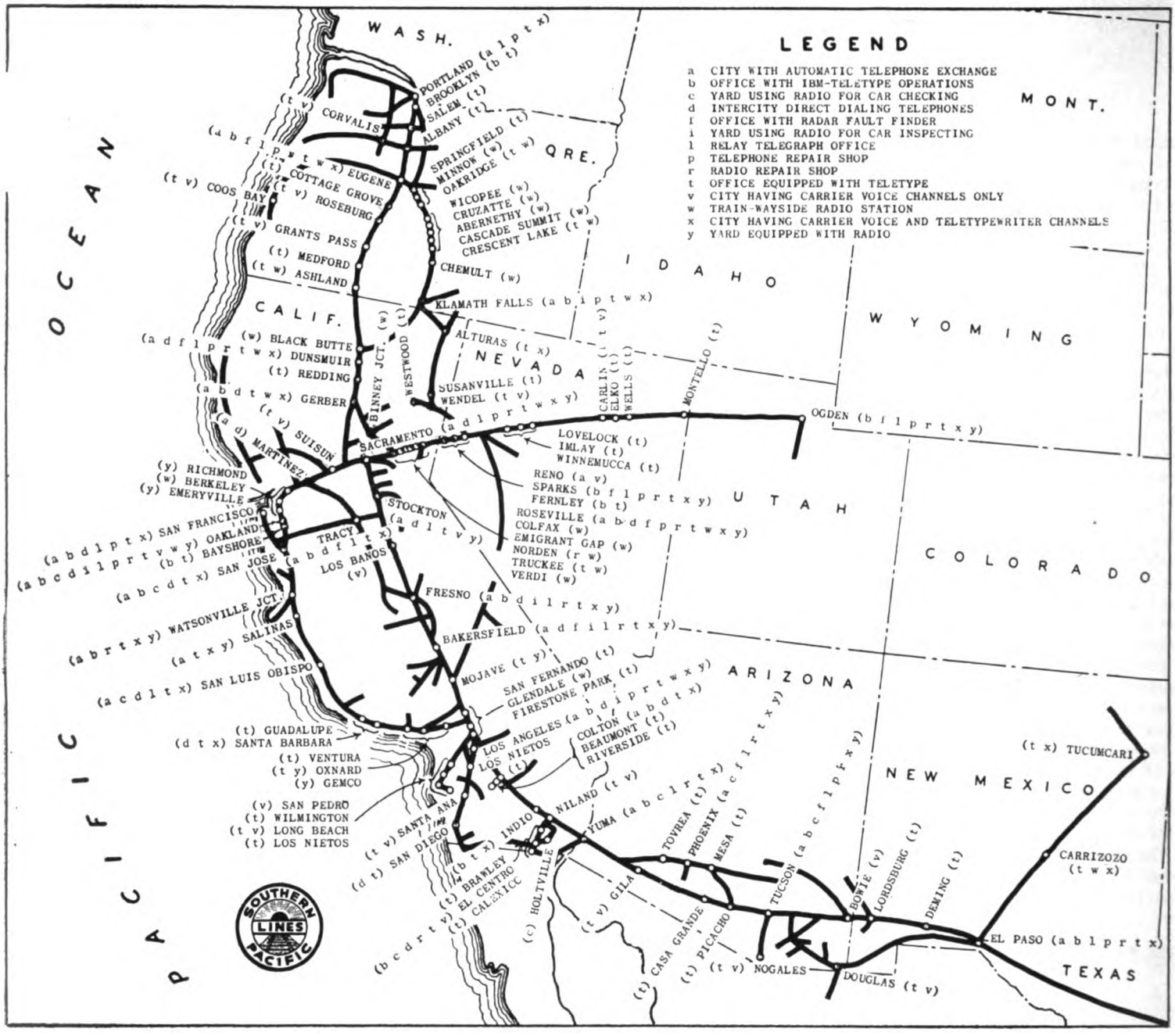


Modern Communications Essential

to Efficient Railroading

SP installs modern, up-to-date communications on the basis of economy and improved service

MECHANIZATION IS BEING applied daily to communications on the Southern Pacific, and not only does this mechanization provide efficient operation, but these modern systems are paying their own way. For example, a railroad expenditure of $34,000 to provide automatic dial telephone service in railroad offices and shops in Richmond, Cal., is saving $22,000 annually in operating expenses. By spending $30,000 for carrier equipment the Southern Pacific replaced leased line circuits, thereby saving 31 per cent on the investment. Dollar savings have been accomplished by the use of radio both in yards and on trains.

"To meet the competition, we must have first class communications," says A. E. DeMattei, superintendent of communications. First class communications on the Southern Pacific includes:

Freight car reporting system using IBM-Teletype equipment linking 21 major yards and the general telegraph office in San Francisco

Teletypwriter network linking 116 on-line offices and 28 off-line offices

Railroad radio on freight trains for end-to-end communications and on all trains for train-to-train as well as dispatcher controls providing communications between dispatchers and trains through wayside stations

Radio in major yards and on

switch engines providing instant communications between yardmasters and switching crews

An intercity automatic dial telephone system covering 70 per cent of the railroad

Talk-back and paging loudspeaker systems in yards for communication among yard personnel and yardmasters.

These are the systems now in service which are continuously being expanded until they will cover the entire railroad, including the lines in Texas and Louisiana where W. F. Fagley is superintendent of communications.

"American railroads are a moving inventory system"

This thought by G. E. Moss, assistant superintendent of communications-operations on Pacific Lines expresses the railroads "place in the sun." The SP communications department is organized into two major divisions—operations, and engineering and maintenance—enabling it to provide fast, accurate transmission of data so necessary in today's railroad operations. Mr. Moss is responsible for the transmission, receipt and delivery of Western Union messages traffic at SP stations; the operation of a system-wide printing telegraph network linking 116 on-line and 28 off-line offices including 21 offices where punched card and Teletype operations originate or are carried on and 18 on-line and two off-line relay telegraph offices; and a telephone system including 26 automatic telephone exchanges with 5,269 extensions. He is assisted in these operational activities by the supervisor of communications operations and two communication traffic supervisors, who program and regulate the operating procedures and routines that are required in the handling of telephone and message communications. He is assisted in the field by five district communications supervisors, the chief operators of 21 telephone exchanges and the managers of 20 relay telegraph offices. To eliminate the daily message close-out among the 90 telegraph offices on the system, the SP uses a system of numbering messages consecutively from 1 through 999, and then starting over again.

The mechanized car reporting system on the SP uses business machine punch cards containing the essential information. From these cards, tape is prepared mechanically, then sent by multiple-send transmitters (send tape to as many as six different offices simultaneously) to adjoining yards and the San Francisco general telegraph office. In yard offices and San Francisco, the transmissions are reproduced on page printers in the form of multiple copies, and on printing reperforators in tape form. In the general telegraph office, the tape of manifest and train consists, as well as a page copy, is "tubed" to the auditor of equipment service accounts where punch cards are made from the tape and then car record and freight traffic information compiled and listed by business machines. This information is then sent to district freight agents and to the traffic department. District agents use these reports to inform customers of their cars' movements. Thirty thousand car movements are reported daily. One-half hour after a train leaves a yard, the consist list is in the San Francisco telegraph office. The SP has ordered four transceivers for this operation, which "read" punch cards and send the information over communications circuits eliminating the necessity of putting the punch card information on a tape for teletypewriter transmission. Transceiver operation insures accurate transmission because the sending of an error stops the receiver, and causes it to send a signal to the transmitter for correction.

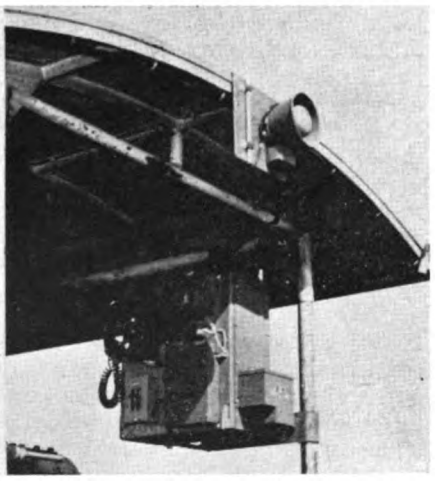
Semi-automatic relaying of communications is performed at six relay telegraph offices—New York, Chicago, San Francisco, Los Angeles, Portland and El Paso general telegraph office. Here's how the system works: for example, a tape (messages) is prepared in Los Angeles with a coded pilot reading DW via BD—DW is Portland, Ore. and BD is San Francisco, Cal. The tape is then placed in a transmitter-distributor and the operator presses a pushbutton to send the messages. At San Francisco, the messages come in on a receiving reperforator. The San Francisco operator takes this tape and puts it in a transmitter-distributor and presses a pushbutton for transmission, and at Portland the messages are received on a printing reperforator and also on a page printer. This type of operation requires the continual checking by the operator for a clear circuit to send the messages.

Under the fully mechanized method of operation (now being considered by the railroad), the operator again will prepare the message in Los Angeles, select the proper circuit, but in this case the tape would be inserted in the transmitter and it would "search" for a line to San Francisco for a predetermined length of time, say 30 sec. If a San Francisco circuit was not available, the tape would go to "storage," and after another 30 sec. it would again come out and "search" for an idle San Francisco circuit, and when it found one, the messages would be sent automatically without the operator pressing a pushbutton when the "clear" circuit was available. The messages would appear in the San Francisco telegraph office on a printing reperforator, as before. This San Francisco tape would automatically "search" for a Portland line, and then be transmitted similar to the operation at Los Angeles. An advantage of automatic operation, according to Mr. DeMattei would be that where they have messages destined for five different locations, they now have to prepare five different pieces of tape, one for each circuit. Under the full automatic operation, one properly coded tape would be prepared, and when moving over a room circuit (in the relay office) it would automatically select a line equipped with five reperforators, mechanically make five tapes and each tape would find its way to destination (search out the proper "clear" circuit and be transmitted).

"Where fast communication is in the interest of the customer, use the phone"—A. E. DeMattei

Telephone usage on the SP has grown as the telephone system has grown—more phones, more usage—and this has been especially true with intercity dialing. Because telephoning is made easy, more people use the phone for long-distance calls which they never made before. "When you are going to write a letter or send a telegram, use the telephone for economy—it costs less than your secretary's time," say Mr. DeMattei. Although the cost of intercity dialing has not been completely offset by the reduction in the operator force. Mr. DeMattei has said "we are not throwing any money away." For this reason, as well as fast communication (a quick answer), the SP has installed an intercity telephone system. Their first long-distance intercity automatic dial telephone system was placed in service between San Francisco and Sacramento, Cal. in November 1953. Five months later, San Francisco and Los Angeles were linked with intercity dialing. By the end of this year, the system will be placed in service from Los Angeles to San Diego and Los Angeles to Yuma, Ariz. Also completed will be San

LINEMAN uses radio to call wire chief



TIE TAMPER is equipped with radio

Francisco to Sacramento and Klamath Falls, Ore, and Eugene, Ore. to Portland. The extension of the system in 1956 will be from Sacramento to Reno, Nev. and Ogden, Utah; Klamath Falls to Eugene; Yuma to Tucson and Phoenix, Ariz. and on to El Paso, Tex. In the meantime, the SP's lines in Texas and Louisiana have likewise inaugurated a similar scheme which will ultimately provide long-distance intercity dialing all the way from Houston, Tex. and New Orleans, La. to Pacific Coast terminals. The Southern Pacific owns the intercity circuits and rents the subscribers' telephone sets and automatic exchanges from commercial telephone companies. An example of the experience of telephone usage is that the San Francisco-Los Angeles service originally required only nine telephone circuits, but now there are seventeen. The telephone system gets approximately two to three times more use with dialing than with manual switchboards.

One method by which the SP obtains increased use of telephone circuits is in releasing physical circuits for local use by superimposing carrier on them for through service. As an example, the local physical message circuit between two major cities is broken into two parts, making the stations on each half of the circuit local party-line extensions off the city exchange on their end. Then carrier is put on the line for providing through service.

An interesting phase of telephone operation is the keeping of an up-to-date directory. As a result of intercity dialing, the number of telephone directories on the railroad has been reduced. A new directory just published covers five divisions in addition to the San Francisco-Oakland area. To keep the directory up-to-date, each listing is put on a punch card, and wnen a telephone number is changed, it is so noted on the card. Number changes average four to five per day, but may run as as high as 100 per day, especially when a new exchange is placed in service. A duplicate card is kept in the publication bureau so that changes in the directory type can be made when telephone numbers are changed. The cards are run through a business machine to produce an alphabetical listing which is distributed to PBX operators. By using the punch card method of directory operation, a new directory can be printed and distributed in about three weeks, considerably less time than was formerly required.

More Circuit Miles—Less Wire Mileage

By the extensive use of carrier, the SP has created 75,000 circuit miles without stringing a mile of wire. Their 47,000 miles of line wire, 7,400 miles of pole line and 50,000 miles of Western Union line wire are maintained by the communications department. This maintenance, as well as installation and engineering of yard and terminal pneumatic tube systems, yard intercom and paging, and local intercom works, is the responsibility of W. J. Garrison, assistant superintendent of communications—engineering and maintenance for Pacific Lines. He is assisted by the communications equipment engineer and the communications plant engineer, and while in the field he is assisted by five district communications supervisors who direct the working activities of linemen, equipment installers and cable splicers.

Several types of carrier are used on the SP, as follows:

*Lenkurt 32E—4-channel voice system.

*Lenkurt 33A—stackable type

* Lenkurt 45A—12-channel voice system

Lenkurt 12A—single-voice channel system

Lenkurt 17 type single-voice channel system

*Western Electric H single-voice channel system

*Western Electric C 3-channel voice carrier system

Lenkurt 22A teletypewriter channels

Federal 9F1 voice carriers

Federal 9E1 telegraph carriers

With so many carrier circuits (telephone and telegraph) working on wire pairs, the need for rapidly locating and repairing wire breaks is essential. SP engineers "put their heads together" and came up with a radar fault finder that enables them to pinpoint cases of wire trouble. Formerly the trouble was generally located between two open telegraph offices, sometimes 20 miles apart, and the lineman had to get on his motor car and patrol the 20 miles until he found the trouble. Now the radar fault finder can tell, sometimes to the pole, where the wire is broken, crossed or shorted out. This location is indicated by the pattern of a wave picture projected on the radar apparatus. The radar fault finder has an effective range up to 100 miles depending upon the kind of metal in the wire circuit, and can be plugged into any telephone or telegraph circuit. The first radar fault finder was placed in service in the Dunsmuir, Cal. telegraph office in 1949, and since then these fault finders have been put into nine other telegraph offices on the SP system.

Practically every yard on the SP has a talk-back speaker system with paging facilities permitting the yardmaster to direct yard operations from a central location. In conjunction with the engineering department, the communications department installs pneumatic tube systems in offices and in yards.

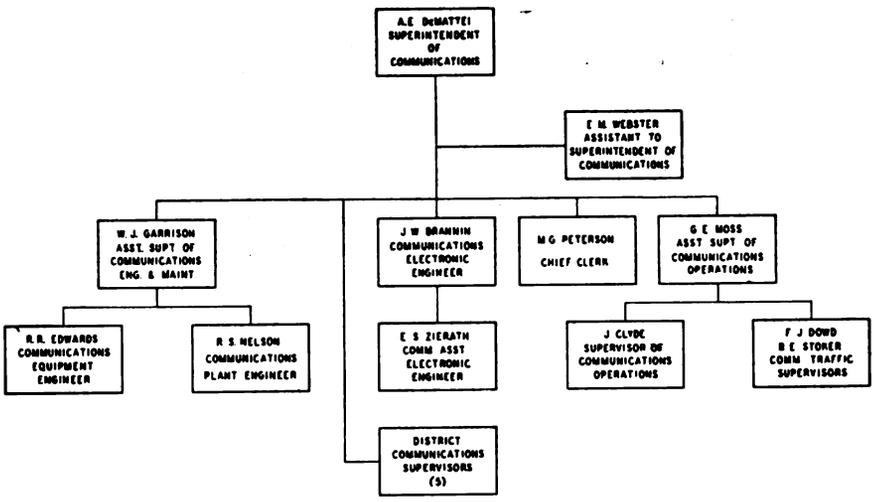
"Radio has become commonplace on the railroad"—D. J. Russell

SP policy is to equip all diesel locomotives with radio, and they are rapidly working toward that goal with cabooses. Presently radio-equipped on Pacific Lines alone are 322 diesel locomotives ("A" units and road switchers), 105 yard switch engines, 8 business cars and 127 ca-

* These carrier systems are used to provide circuits for the inter-city automatic dial telephone system.

booses. Radio is used from head to rear end on trains, from fixed stations, from radio-equipped automobiles and other mobile stations, on ferry boats, on snow fighting equipment, and in yards. Remote control or fully automatic radio repeater stations are also used for extending coverage. An SP first is a dispatcher radio system which enables the dispatcher at his terminal to contact any train in his district. This is now in service in the Sierra Nevada (Sacramento-Sparks, Nev.) and Cascade mountains (Eugene-Crescent Lake, Ore.). The systems are to be placed in service over the Tehachapi mountains in southern California between Bakersfield and Mojave; between Los Angeles and Colton, Cal.; and between El Paso, Tex. and Tucumcari, N. Mex. The dispatcher radio control system from Sacramento also has a connection with the office of the general superintendent of transportation and superintendent of communications in San Francisco, enabling them to contact trains in case of emergency. At present, 27 wayside offices on Pacific Lines alone are equipped with radio for train-to-wayside communication. Radio is used extensively in yards, 18 on Pacific Lines being so equipped for instant communication between yardmasters and switch engine crews. Eleven Pacific Lines yards use radio for car checking and five for car inspecting; the checkers and inspectors carrying walkie-talkies. Thirty-six automobiles are radio equipped which include such diverse users as superintendents (3), trainmasters (6), equipment installers (8), yardmasters (4) and crew callers (4).

This policy of providing communications wherever possible to save time and money, has produced many new and often startling uses of radio. For example, radio communication played an important part in the daylighting of tunnels and the reconstruction of the line through the Tehachapi mountains between Bakersfield and Mojave following an earthquake in August 1952. Emergency radio stations were set up in the mountains to talk to Bakersfield and to work trains in the area. Much time was saved in keeping everyone informed of general progress and in transmitting instructions to workers and foreman. Radio is also saving time for a lineman working out of Dunsmuir, Cal. His motor car is radio-equipped, which enables the Dunsmiur wire chief to radio him about wire trouble as soon as it occurs, and tells him the location (from radar fault finder). The lineman receives the call promptly, and the wire chief doesn't have to wait for the lineman to call in when he is out on the line. Radio also enables them to discuss the trouble as though they were in the same room. This person-to-person contact when hunting trouble is most valuable.



ORGANIZATION of SP's Pacific Lines communications department

The use of radio on on-track work equipment has reduced delays to freight and passenger trains. On the Sacramento division, a Matisa tamper and a Burro crane have been radio-equipped, and each with tripod-mounted radios used by the flagmen enabling them to warn approaching trains of the work equipments' locations, as well as receiving instructions from the foreman or supervisor of the equipment. The radio on the equipment itself enables the dispatcher to contact the supervisor, ascertaining their exact location, and keep them informed about train movements.

Snowfalls of 8 to 10 ft. and up are usual for the Sierra Nevada and Cascade mountains. To aid them in their annual battle against the snow, dispatcher radio systems were installed over these districts as well as equipping snow fighting equipment, including eight rotary snow plows, seven flangers and five Jordan spreaders. Weather reports, including snowfall, can be transmitted to the dispatcher who informs the division superintendent—and "the battle is on." Radio can be used to keep all informed about snow conditions and how the "snow fighters" are doing.

The SP has three ferry boats operating across San Francisco bay between Oakland and San Francisco. Each boat is equipped with two sets of radar and radio—one at each end on the "bridge." Eight business cars are also equipped with radio, these covering nearly the entire system.

At Abernethy, Ore., the SP installed an experimental radio repeater station on a hill to enable the dispatcher at Eugene to call trains in the Cascade mountains when the line wires are out between the regular wayside radio stations and the next repeater station enables him to call any trains in the district (about 44 miles). This area is subject to 15 ft. of snow, 100 mph winds, snow slides, washouts, falling trees, and fires which often take out the pole line.

J. W. Brannin, electronics engineer, is responsible for the engineering, supervision and maintenance of all Pacific Lines radio systems and allied electronic equipment, and the processing of FCC license applications. Seventeen repair shops are in operation on the railroad for the maintenance of radio equipment.

TV Replaces Yardmasters' Towers

This is a definite possibility. Results of day and night testing of television viewing of 13 locations at Taylor yard in Los Angeles are being studied with the idea of applying a similar TV system at other locations. Estimates are that a TV system with viewers in a ground-floor yardmaster's office could pay for itself in three to five years. The system under consideration will have as many as seven cameras with wide-angle lenses and five cameras with telephoto lenses providing general view and "on-the-spot" coverage of a two-mile long yard. To obtain the same supervisory control and viewing as that obtainable with television the SP estimates that two yardmasters' towers would be needed, one at each end of the yard.

(*Continued on page* 44)

These track lamps are amber and are normally lighted; being extinguished when corresponding sections of track are occupied.

Just below the symbol for each street there is a red lamp which is extinguished when the gates are in the lowered position at the corresponding crossing. Below the symbol for each crossing is a toggle type lever, the purpose for which is to place the protection in operation and lower the gates at a crossing, independent of track circuit control; for example to protect a crossing during the passage of a track motor car. Such a lever is normally in the raised position and is thrown to the "down" position to lower the gates at the corresponding crossing, and is thrown back to the "up" position to raise the gates.

To Clear Gates With Track Occupied

In some instances the switch engine occupies an approach section and sets the protection in operation and lowers the gates at a crossing, such as Maple St., but stops short of that crossing to set out cars on a spur. When the towerman sees that the switch engine has stopped, he puts his foot on his foot switch and, in the group of buttons applying for Maple St., he pushes the button marked "NB Track Raise." This causes the gates at Maple to raise and the flashers are cut out. Thus street traffic can move over the crossing with no further delay. (This manual control to raise the gates is not effective if the short track circuit across the width of the street is occupied, or if a train occupies an approach circuit on the southbound track.)

By watching the switch engine, the towerman can see when a move is to be made toward Maple St., and then, in the group applying to Maple St., he pushes the button marked "NB Track Lower." This cuts out the manual control, and the automatic track circuit control takes effect to operate the flashers and lower the gates. For such a move on the southbound track, the two buttons to the left of the vertical toggle switch would be used. Controls applying to protection at the other crossings are accomplished in a corresponding manner.

The use of a foot switch, mounted on the floor below the control panel, is a special Delaware & Hudson feature, the purpose being to insure that the towerman is alert while operating the manual controls, the warning apparatus reverting to automatic operation if the towerman moves away from the control cabinet or for any reason releases the foot switch.

A towerman is on duty in this cabin from 6 a.m. to 10 p.m. Monday through Saturday, six days each week. When the towerman is ready to depart, he throws the "Off Duty Switch" on his panel to the "Off" position. This cuts off the indication lamps on the panel and the approach annunciator bell.

Local Manual Control

On the track side of the instrument house at each crossing there is a cast iron box which is locked with a switch padlock. Inside this box is a small panel with four pushbuttons. If a train makes an unusual stop and is to stand for some time on the track circuits controlling the gates, a member of the train crew or other authorized railroad employee can unlock the box and push the "Stop" button corresponding with the track occupied by the train. Then the gates at the crossing are raised, and the flashing-light signals are cut out. When the train is ready to start again, the "Start" button for that track must be pushel to operate the flashing light signals and lower the gates. This local manual control is intended for emergency use on Sunday and between 10 p.m. and 6 a.m. when no towerman is on duty.

At each crossing the gate motors are fed by a set of seven 240-a.h. Exide lead storage cells. At Maple St. a local battery for control circuits consists of eight 150-a.h. Edison storage cells. Each track circuit is fed by one 75-a.h. Edison storage cell. The lamps in the flashing-light signals and on the gate arms are normally fed from transformers. If the a.c. fails, a power-off relay switches the lamps to the battery feed.

A D&H standard practice is to provide a sheet-metal instrument house for the relays, rectifiers, transformers and battery at each crossing at which gates and flashing-light signals are being installed. At Elm St. the house is 6 ft. by 6 ft. and at each of the other two crossings the house is 6 ft. by 8 ft.

This installation was planned and installed by Delaware & Hudson forces under the direction of C. H. Tobin, signal engineer and superintendent of telegraph. The gates, flashing-light signals and manual control machine were furnished by the Western Railroad Supply Company, and the relays and rectifiers by the General Railway Signal Co.

S. P. COMMUNICATIONS

(*Continued from page* 35)

Microwave—Weatherproof Communications

Between Dunsmuir and Black Butte at the foot of Mt. Shasta in northern California, the SP is contemplating the installation of microwave. Emergency repairs to the pole line may take days or even weeks in the winter. Winds up to 100 mph and snow falling at the rate of ½ ft. per hr. are not uncommon. This is probably the "worst-weather" section of the railroad. Microwave terminal stations would be at Dunsmuir and Black Butte, 25 miles apart with a repeater station at Mt. Shasta eight miles south of Black Butte. The microwave signal is beamed from Dunsmuir to a hill-top passive reflector then direct to the drop-out repeater at Mt. Shasta; from there to a passive reflector on a hill-top and then direct into the Black Butte terminal station. The system will have 21 microwave channels with five channels dropped out at Mt. Shasta. Sixteen channels will provide through service for the dispatcher's radio system, telephone, printing telegraph service, CTC controls and standby. There will be 100 per cent standby, both microwave and power, at the terminals and repeater stations with automatic changeover to standby equipment. This microwave system will replace the present signal and communications pole lines between Dunsmuir and Black Butte.

Planning the engineering and operational applications of communications equipment to coordinate its use with future installations is one of the basic controls of planning programs. For example, the multichannel telephone and Teletype carrier systems now being installed on wires can be applied to future radio and microwave installations. Planning schedules include one, five and ten year programs. A five-year planning program being completed this year is the system-wide Morse to telephone conversion program. Another five-year program is the intercity dialing with "tandem dialing" which enables users to dial from their exchange to an adjoining one and thence automatically to another distant exchange.

Training systems now in operation for employees are on-the-job training for wire chief-mechanicians, brush-up shop training for linemen and equipment installers, and factory training for department personnel in radio and allied electronics.